Section: Anaesthesia

Original Research Article

COMPARATIVE STUDY OF EFFICACY OF ESMOLOL AND DEXMEDETOMIDINE FOR CONTROLLED HYPOTENSION IN FUNCTIONAL ENDOSCOPIC SINUS SURGERY

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ABSTRACT

Background: We compared the efficacy of Esmolol versus Dexmedetomidine in achieving and maintaining controlled hypotension in Functional Endoscopic Sinus Surgery under General Anaesthesia.

Materials and Methods: Sixty patients of ASA-I/II scheduled for B/L functional endoscopic sinus surgery were selected and were randomly allotted into two groups of thirty each. Group D received loading dose of Dexmedetomidine 1µg/kg over 10 min followed by infusion of 0.2-0.7µg/kg/hr and Group E received Esmolol in loading and maintenance dose of 1mg/kg over 1min and 0.2-0.7 mg/kg/hr, respectively. Both the infusions were titrated to maintain a mean arterial blood pressure between 65-75 mmHg. Visibility of surgical field was assessed by surgeon using Average Category Score. Hemodynamic variables, emergence time, number of additional intermittent doses of vecuronium and time to first analgesic request were recorded. Postoperative sedation was assessed using Ramsay Sedation Score. Adverse effects if any were noted.

Results: Dexmedetomidine was associated with more stable hemodynamic parameters like MAP, SBP, DBP and HR intra- operatively and following stoppage of study drugs.

Conclusion: We concluded that both dexmedetomidine and Esmolol are effective in providing ideal surgical conditions during FESS. Dexmedetomidine is preferred over Esmolol.

Keywords: Fess, controlled hypotension, Dexmedetomidine, Esmolol. Average category score, Ramsay sedation score, Emergence time.

INTRODUCTION

Functional endoscopic sinus surgery (FESS) is highly sophisticated type of surgery, which has revolutionized the surgical management of acute and chronic sinus pathologies when conservative management has failed.[1] During FESS the surgeon operates in a confined space with a severely limited field of view on delicate and highly vascular structures.[2] The rich blood supply of sinuses compromises the surgical field due to bleeding,[3] resulting in complications such as orbital hematoma, extra-ocular muscle damage,[4] cerebrospinal fluid fistula, intracranial injuries,[5] and injury to nearby vital structures such as the optic nerve, internal carotid artery and nasolacrimal duct.[6] To minimize these complications, effective control of bleeding at the surgical site is required. Controlled hypotension is one of the most effective methods of reducing intra-operative bleeding.[7] It is a technique in which the arterial blood pressure is decreased in a predictable and deliberate manner to facilitate surgery, reduce bleeding and thereby improving the quality of surgical field visualization.[8,9] In controlled hypotension during anaesthesia, the blood pressure of the patient is reduced such that the mean arterial pressure (MAP) is lowered by 30%,[10-13] from baseline or at 60-70 mmHg, whichever is

greater. For this purpose, several agents such as magnesium sulphate,[14] Nitro glycerine,[15] higher doses of inhaled anaesthetics,[16] vasodilators like sodium nitroprusside,[17] short acting opioid like remifentanil,[18] beta-blockers,[19] like Esmolol, and alpha-2 agonist like Dexmedetomidine,[20] and clonidine,[21] have been used either alone or in combination. Although these pharmacological agents effectively lower the blood pressure, they are associated with delayed recovery from inhaled anaesthetics, resistance to vasodilators, tachyphylaxis, and cyanide toxicity from nitroprusside. An ideal agent having characteristics such as faster onset, rapid elimination without toxic metabolites, easy administration, short context-sensitive half-life and dose-dependent predictable effects is yet to be discovered.[10] So present clinical randomized study was undertaken to compare the efficacy of Esmolol and Dexmedetomidine as a hypotensive agent in functional endoscopic sinus surgery with attention on the quality of surgical field, emergence time, sedation score, number of intermittent doses of muscle relaxant required and to evaluate the side effects, if any. Esmolol is an ultrashort acting selective β1 adrenergic antagonist that reduces heart rate and blood pressure. It has rapid onset of action on bolus iv. injection and infusion whereas Dexmedetomidine is a potent highly selective α2 adrenergic receptor agonist. It has sedative, analgesic, anaesthetic sparing effect, and sympatholytic properties.

MATERIALS AND METHODS

This is a prospective randomised comparative study that was carried out on ASA GRADE I and II, patient of either sex, aged 18 – 60 yrs, undergoing B/L functional endoscopic sinus surgery in Jaipur Golden Hospital Rohini New Delhi, after obtaining approval from institutional ethical committee and written informed consent from all participants. A total of 60 patients scheduled for B/L functional endoscopic sinus surgery were screened and recruited for study based on predefined inclusion and exclusion criteria. Patients were randomly divided into two groups as per intervention by two different anaesthesia technique. Group D consisted of 30 cases who received Dexmedetomidine for controlled hypotension and Group E consisted of 30 cases who received Esmolol for controlled hypotension. Sample size calculation. Sample size calculation was done on basis of pilot studies done for analysis of effect of dexmedetomidine and esmolol for various haemodynamic parameters, surgical site bleeding and post operative complications. Keeping power (1-beta error) at 80% and confidence level (1-alpha error) at 95%. The minimum sample size required was 23 patients, therefore we included 30 patients in each group. The patient and observer of this study were blinded of the group allocation of the patient. All basic investigations and Pre-anaesthetic checkup were done. All the patients were advised to be nil by mouth for at least 8 hours for heavy solid meal, 6 hours for semisolid or juices and 2 hours for plain water prior to time of surgery. On arrival in pre-operative line area, the patient's vital parameters were recorded and considered as baseline parameters. Group allocation was done as per randomization protocol. In the operation theatre iv line was established and multipara monitor were connected (ECG, NIBP, SPO2 ETCO2 and PNS.) In Group D, patients received loading dose of 1 µg/kg Dexmedetomidine diluted in 10 ml 0.9% saline infused over 10 min, before induction of anaesthesia, followed by continuous infusion of 0.2 – 0.7µg/kg/h during maintenance of anaesthesia through infusion pump. In Group E, patients received Esmolol as a loading dose 1 mg/kg, infused over 1 min, before induction of anaesthesia, followed by continuous infusion of 0.2-0.7mg/kg/h during maintenance of anaesthesia through infusion pump. All the infusions were titrated to maintain a mean arterial blood pressure between 65-75 mmHg. Preoperatively in both groups cottonoids soaked with epinephrine in a concentration of 1:80.000 was inserted into the nasal cavity and in between the polyps to minimize blood loss. All patients were premedicated with inj. Glycopyrrolate 0.2 mg, inj. Midazolam 1mg and inj. Fentanyl 1.5mcg/kg intravenously. After preoxygenation with 100%oxygen, patients were induced with propofol 1.5 mg/kg intravenously and intubation was facilitated with inj. Succinylcholine 1.5mg/kg. Loading dose of inj. vecuronium 0.1 mg/kg was given. Anaesthesia was maintained with 40% oxygen +60% N20, isoflurane@1MAC and inj. Vecuronium 0.01mg/kg Intermittent dose of vecuronium was given depending on TOF response. Intra-operatively hemodynamic parameters such as Pulse Rate, Non-invasive blood pressure (Systolic Blood Pressure, Diastolic Blood Pressure & Mean Arterial Pressure) were recorded at baseline, after the loading dose, after induction, after intubation, thereafter every 10 minutes until the end of surgery and lastly 1 and 5 minutes after extubation. The surgical site was observed by the surgeon every 10 minutes for the severity of bleeding and the need for frequent suctioning and was recorded according to predefined average category score proposed by Fromme et al.[22]

Table 1: Average category score

0	**No Bleeding**
1	Slight bleeding– no suctioning of blood required
2	Slight Bleeding – occasional suctioning required. Surgical field not threatened
3	Slight bleeding- frequent suctioning required. Bleeding threatens surgical field a few seconds after suction is removed.

4	Moderate bleeding- frequent suctioning required. Bleeding threatens surgical field directly after suction is removed.
5	Severe bleeding – constant suctioning required bleeding appears faster than can be removed by suction. Surgical field severely threatened and surgery not possible.

The ideal category score values for surgical conditions were predetermined to be 0-3. The infusion of the study drug was stopped five minutes before the anticipated end of surgery. Throat pack was removed after the completion of surgery and residual blood if any was suctioned using suction catheter. When TOF twitch count was recorded >2, residual neuro muscular blockade was reversed with Neostigmine (0.05mg/kg) and Glycopyrrolate (0.01mg/kg). Extubation was done when TOF ratio was recorded >0.9 and patient was fully awake and followed verbal commands. 29 Material and Methodology Intraoperatively all patients received inj. Paracetamol 1 gm iv infusion over 20 minutes and inj. Ondensteron 0.1mg/kg iv as additional analgesic and anti-emetic respectively. The number of intermittent maintenance dose was recorded. Emergence time, defined as the time interval between discontinuation of anaesthetics and response of eye opening to verbal command was recorded. The post-operative sedation was assessed every 20 minutes up to 1 hour after surgery by using Modified Ramsay Sedation score.

Table 2: Modified Ramsay sedation score

1	**Anxious, agitated, or restless**
2	Cooperative, oriented, and tranquil
3	Responsive to commands
4	Asleep, but with brisk response to light, glabellar tap, or loud auditory stimulus
5	Asleep, sluggish response to glabellar tap, or auditory stimulus
6	Asleep, no response

Post operative analgesia was assessed by the time to first analgesic request by the patient. Patients were monitored in the post operative ward for any complications including nausea, vomiting, bradycardia or tachycardia, hypotension or hypertension, during the first 24 hours following surgery.

Normally, distributed continuous variables were compared using unpaired t test, whereas the Mann-Whitney U-test was used for those variables that were not normally distributed. SSPS 21.0 software was used for statistical analysis and P<0.05 was taken as statistically significant.

Inclusion Criteria

- ASA grade I or II
- Between 18 to 50 years of age
- Willing to give written informed consent

Exclusion Criteria

- Refusal to participate.
- ASA grade III or above.
- Bleeding diathesis
- Pregnancy and lactating mother
- Psychological disorder.
- Patients with any cardiac comorbidity.
- Patients with pulmonary, Renal, hepatic or cerebral insufficiency
- Known allergy to study drug.

Table 3: Comparison of age, gender and ASA distribution in studied cases

	Group D (N=30)	**Group E (N=30)**	**P value**
Gender distribution			
Male/Female	25/5	26/4	0.7194(Not significant Fisher test)
Age distribution			
18-30 yrs	14 (46.67%)	15(50%)	0.7437(Not significant)
31-40 yrs	10(33.33%)	10(33.33%)	
41-50 yrs	6(20%)	5(16.67%)	
Mean ± SD	32.1 ± 8.4	31.4 ± 8.1	
ASA grade			
ASA I/II	23/7	22/8	0.7670(Not significant fisher test)

Table 4: Anthropometric parameters in studied cases

anthropometric parameters	**Group D (N=30)**	**Group E (N=30)**	**P value**
Height (cm)			
Mean ± SD	**166.70** ± 4.62	**167.80** ± 5.77	**0.4184**
Weight (kg)	**68.17** ± 10.55	**67.17** ± 11.02	**0.7209**
BMI(kg/m^2)	**24.41** ±2.78	**23.71** ± 2.52	**0.3104**

RESULTS

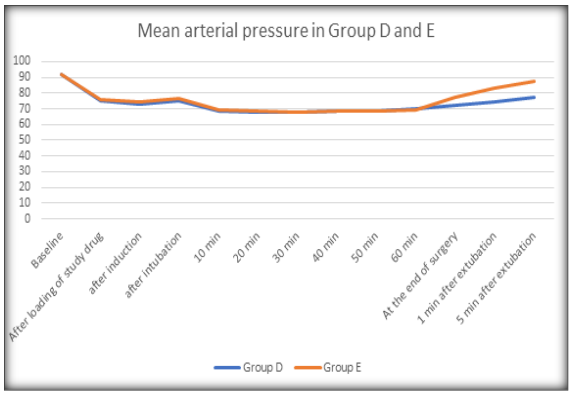
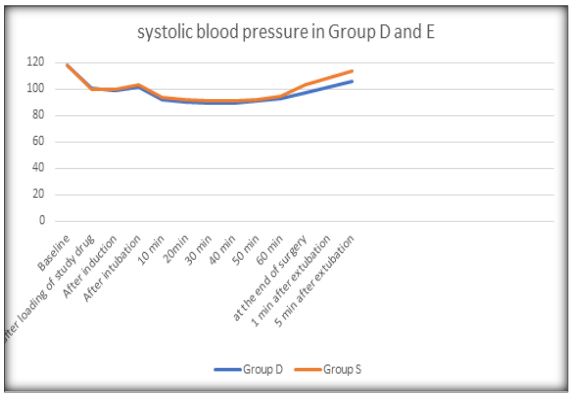


Figure 1



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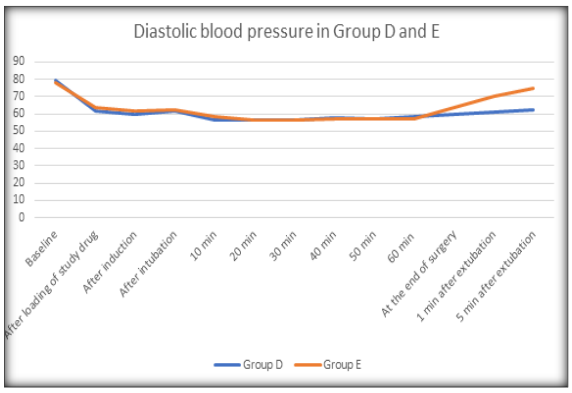

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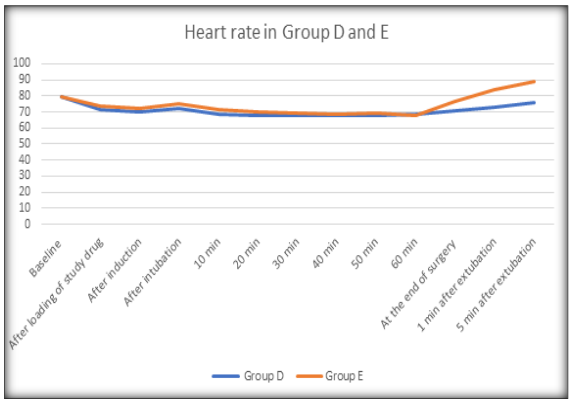

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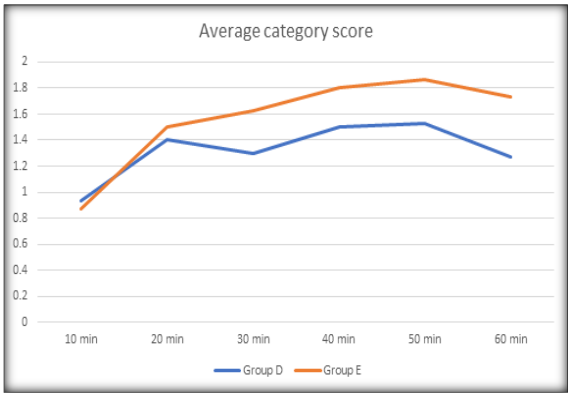
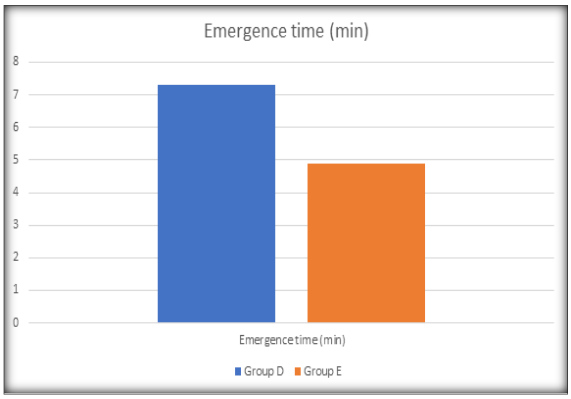


Figure 5



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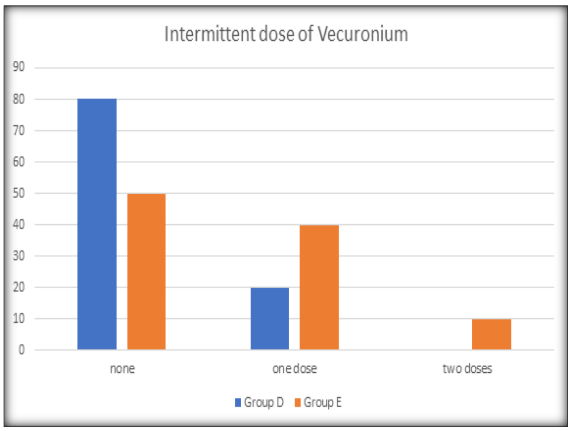

Figure 7

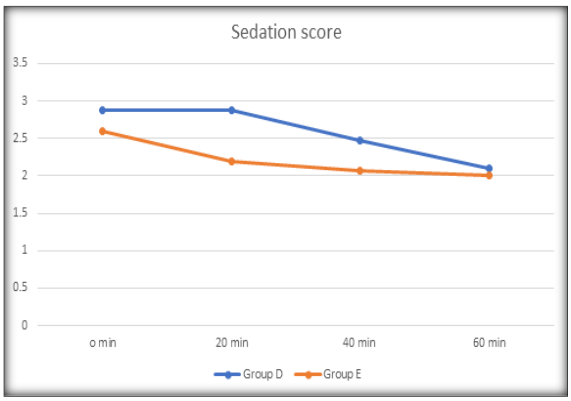

Figure 8

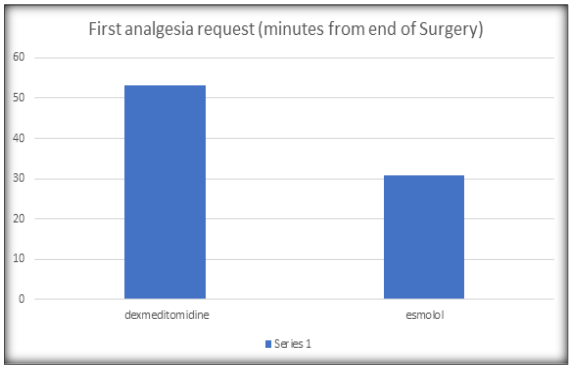

Figure 9

The study was conducted in a prospective randomised way in 60 patients (30 patients in each group) who received Dexmedetomidine (Group D) or Esmolol (Group E) for controlled hypotension in FESS (functional endoscopic sinus surgery). Demographic and anthropometric data were tabulated, and test of statistical significance were performed for inter group comparison. The analysis of age and gender distribution showed that the mean age in Group D was 30.70±8.79 years and in Group E was 30.70 ± 8.20 years. There was no significant difference in age distribution between the groups (P = >0.999). An overall preponderance of males was seen in both the groups with 83.33% in Group D and 86.67% in group E. However, the difference in gender distribution in both groups was statistically insignificant(P=0.7194) (table 3)

The mean weight distribution in both the groups was comparable with no statistically significant difference (P=0.7209). Mean weight in Group D was 68.17 ± 10.55 kg and Group E was 67.17 ± 11.02 kg. Similarly on analysis of height distribution in both the groups showed comparable results with no statistical difference (P=0.4184). Mean height in group D was 166.70 ± 4.62 cm and in group E was 167.80 ± 5.77 cm. On Comparing the BMI distribution of two groups there was no statistical difference (P=0.3104). The mean BMI of group D was 24.41 ± 2.78 and group E was 23.71 ± 2.52. (table 4)

On comparison of mean arterial pressure between two groups we found that baseline mean arterial pressure in group D was 92.22 ± 1.75 and in group E was 91.80 ± 2.26, which was without any statistically significant difference. (P=0.4242). After loading of study drug, group D was having mean arterial pressure of 74.89 ± 1.31 and Group E had mean arterial pressure of 76.04 ± 2.50 representing a fall of 18(mmHg) and 15(mmHg) respectively and the difference was statistically significant(P=0.0295). The mean arterial pressure in Group D was 72.36 ± 1.13, 74.47 ± 1.01, 77.02 ± 0.99 at the end of surgery, 1 min after extubation and 5 min after extubation respectively where as in Group E mean arterial pressure was 77.07 ± 1.54,82.96 ± 1.46 and 87.84 ±1.35 at the end of surgery, 1 min after extubation and 5 min after extubation respectively Both groups showed decline in mean arterial pressure following loading dose of study drugs, till stoppage of study drugs, however decline in group D was significantly higher as compared to group E with P value < 0.001.

On comparison of mean Systolic and Diastolic blood pressure between two groups we found that baseline SBP/DBP in group D was 118 ± 3.19/79.33 ± 2.59 and in group E was 118.60 ± 3.53/78.40 ± 2.37 which was without any statistically significant difference. (P=0.4925). After loading of study drug, group D was having mean SBP/DBP of 100.67 ± 1.84/ 62.00 ± 1.97 and Group E had mean SBP/DBP of 101.20 ±2.14/63.47 ± 3.23 representing a fall of 18/17(mmHg) and 17/15(mmHg) respectively and the difference was statistically significant(P=0.0376). The mean SBP/DBP in Group D was 97.07 ± 1.64/60.00 ±1.49, 101.40 ± 1.59/61 ± 1.36, 106 ± 1.49/62.53 ± 1.38 at the end of surgery, 1 min after extubation and 5 min after extubation respectively where as in Group E mean SBP/DBP was 103.47 ± 2.16/63.87 ± 2.11,108.60 ± 2.42/70.13 ± 2.22 and 113.80 ± 2.48/74.87 ± 2.27 at the end of surgery, 1 min after extubation and 5 min after extubation respectively Both groups showed decline in mean SBP/DBP following loading dose of study drugs, till stoppage of study drugs, however decline in group D was significantly higher as compared to group E with P value < 0.001.

On comparison of mean HR between two groups we found that baseline HR in group D was 79.90 ± 2.48 and in group E was 79.80 ± 2.41, which was without any statistically significant difference. (P=0.8747). After loading of study drug, group D was having mean HR of 71.53 ± 1.96 and Group E had HR of 73.60 ± 2.39 representing a fall of 8(bpm) and 6(bpm) respectively and the difference was statistically significant(P=0.0005). The HR in Group D was 70.93 ± 1.55, 73.17 ± 1.56, 75.63 ± 1.86 at the end of surgery, 1 min after extubation and 5 min after extubation respectively where as in Group E HR was 76.43 ± 2.94,83.87 ± 2.15 and 89.33 ±2.83 at the end of surgery, 1 min after extubation and 5 min after extubation respectively Both groups showed decline in HR following loading dose of study drugs, till stoppage of study drugs, however decline in group D was significantly higher as compared to group E with P value < 0.001.

The study compared two groups (Group D and group E) with respect to emergence time, sedation scores, and time to first analgesic request. Both groups has ACS (Average category Score) ranging from 1-3, but Group E demonstrated a significantly higher average category score from 30 min onwards (P= 0.05)

The mean emergence time was markedly shorter in Group E(4.90 min) compared to group D(7.13 min), with high statistical significance (p<0.001). similarly, sedation scores were higher in group D at 20 and 40 min.

In terms of postoperative analgesia, the time to first analgesic request was significantly longer in Group

D (53.23 min) compared to group E (30.67 min) with a very strong statistical significance (p<0.000).

Table 5: Comparison of Mean arterial pressure in group D and group E

Mean arterial pressure	Group D		Group E		P value
	Mean	S.D	Mean	S.D	
Baseline	92.22	1.75	91.80	2.50	0.4242
After loading of study drug	74.89	1.31	76.04	2.50	0.0295
After induction	72.89	1.15	74.36	2.37	0.0034
After intubation	74.93	1.43	69.13	2.78	0.0151
10 min	68.53	2.36	68.58	5.35	0.5763
20 min	67.87	1.91	68.02	0.95	0.0735
30 min	67.62	2.00	68.02	1.13	0.3442
40 min	68.39	1.83	68.31	1.35	0.8479
50 min	68.64	1.35	68.76	1.28	0.6604
60 min	69.93	1.14	69.60	1.31	0.3023
At the end of surgery	72.36	1.13	77.07	1.54	<0.0001
1 min after extubation	74.47	1.01	82.96	1.46	<0.0001
5 min after extubation	77.02	0.99	87.84	1.35	<0.0001

Table 6: Comparison of Systolic blood pressure in Group D and E

Systolic blood pressure	Group D		Group E		P value
	Mean	S.D	mean	S.D	
Baseline	118	3.19	118.60	3.53	0.4925
After loading of study drug	100.67	1.84	99.87	1.89	0.3079
After induction	98.93	1.64	99.87	1.89	0.0441
After intubation	101.73	2.56	103.73	3.59	0.0159
10 min	92.40	2.85	94.00	1.89	0.0130
20 min	90.40	2.13	92.53	1.66	0.0001
30 min	89.53	2.71	91.53	2.27	0.0030
40 min	89.83	2.20	91.07	2.21	0.0335
50 min	91.27	1.93	92.27	1.87	0.0461
60 min	93.27	1.70	94.40	1.85	0.0167
At the end of surgery	97.07	1.64	103.47	2.16	<0.0001
1 min after extubation	101.40	1.59	108.60	2.42	<0.0001
5 min after extubation	106.00	1.49	113.80	2.48	<0.0001

Table 7: Comparison of diastolic blood pressure in Group D and Group E

Diastolic blood pressure	Group D		Group E		P value
	Mean	S.D	mean	S.D	
Baseline	79.33	2.59	78.40	2.37	0.1522
After loading of study drug	62.00	1.97	63.47	3.23	0.0376
After induction	59.87	1.66	61.60	3.17	0.0104
After intubation	61.53	1.72	62.67	3.12	0.0850
10 min	56.60	2.79	58.20	1.52	0.0078
20 min	56.60	2.30	56.60	1.50	>0.999
30 min	56.67	2.06	56.27	1.55	0.3989
40 min	57.67	2.47	56.93	1.46	0.1631
50 min	57.33	1.60	57.00	1.54	0.4334
60 min	58.27	1.46	57.20	1.54	0.0077
At the end of surgery	60.00	1.49	63.87	2.11	<0.0001
1 min after extubation	61.00	1.36	70.13	2.22	<0.0001
5 min after extubation	62.53	1.38	74.87	2.27	<0.0001

Table 8: Comparison of heart rate in group D and Group E

Heart rate	Group D		Group E		P value
	Mean	S.D	mean	S.D	
Baseline	79.70	2.48	79.80	2.41	0.8747
After loading of study drug	71.53	1.96	73.60	2.39	0.0005
After induction	69.97	1.97	72.53	2.40	<0.0001
After intubation	72.37	1.65	74.87	2.18	<0.0001
10 min	68.37	1.22	71.37	1.87	<0.0001
20 min	67.77	0.82	69.77	2.39	<0.0001
30 min	67.73	0.94	68.97	2.04	0.0037
40 min	67.53	0.94	68.83	1.53	0.0014
50 min	67.67	1.06	68.97	1.77	0.0010
60 min	68.77	1.70	68.20	0.89	0.1092
At the end of surgery	70.93	1.55	76.43	2.94	<0.0001
1 min after extubation	73.17	1.56	83.87	2.15	<0.0001
5 min after extubation	75.63	1.81	89.33	2.83	<0.0001

Table 9: Comparison of average category score between Group D and Group E

Average category score	Group D		Group E		P value
	Mean	S.D	Mean	S.D	
10 min	0.93	0.69	0.87	0.68	0.7357
20 min	1.40	0.50	1.50	0.51	0.4463
30 min	1.30	0.47	1.63	0.49	0.0100
40 min	1.50	0.51	1.80	0.48	0.0224
50 min	1.53	0.51	1.87	0.43	0.0071
60 min	1.26	0.45	1.73	0.52	0.0005

Table 10: Comparison of emergence time between Group D and Group E

Operative Parameters	Group D		Group E		P value
	Mean	S. D	Mean	S. D	
Emergence time(min)	7.13	1.01	4.09	1.21	<0.0001

Table 11: Comparison of intermittent dose of vecuronium between Group D and Group E

Intermittent dose of vecuronium	Group D	Group E	P value
none	24(80%)	15(50%)	0.0157
Needed	6 (20%)	15(50%)	
1	6(100%)	12(80%)	
2	0	3(20%)	
Total	30	30	

Table 12: Comparison of sedation score between Group D and E

Sedation score	Group D		Group E		
	Mean	S .D	Mean	S .D	
O min	2.87	0.57	2.60	0.50	0.0560
20 min	2.87	0.57	2.20	0.41	<0.0001
40 min	2.47	0.51	2.07	0.25	0.0003
60 min	2.10	0.31	2.00	0.15	0.1172

Table 13: First analgesia request (minutes from end of Surgery)

Time of first analgesia request	Group D		Group E		P value
	Mean	S .D	Mean	S .D	<0.0001
Minutes from end of surgery	53.23	5.84	30.67	6.48	

DISCUSSION

Bleeding is undesirable during any surgical procedure since it impairs the view of surgical field leading to injury to nearby vital structures with increase in surgical time. An important technique to reduce bleeding during the surgery is controlled reduction in blood pressure to such levels so that bleeding is minimal, but at the same time perfusion to the vital organs is well maintained. This is the underlying concept for controlled hypotensive anaesthesia.

Controlled hypotension is regarded as an effective technique for reducing blood loss and optimizing the surgical field during FESS. Many studies have been conducted by various research workers over the years using different pharmacological agents such as Nitroglycerine,[15] higher doses of inhaled anaesthetics,[16] vasodilators like sodium nitroprusside,[17] short acting opioid like Remifentanil,[18] beta-blockers,[19]like Esmolol, and alpha-2 agonist like Dexmedetomidine and Clonidine either alone or in combination in the quest for an ideal agent for controlled hypotension. Some of the agents were associated with side effects such as delayed recovery from inhaled anaesthetics, resistance to vasodilators, tachyphylaxis, and cyanide toxicity from nitroprusside.

Therefore, we have chosen two pharmacological agents (Esmolol and Dexmedetomidine) for comparison in inducing hypotension in FESS considering their short duration of action and minimum effect on respiration.

Dexmedetomidine is a highly selective α2 adrenergic receptor agonist and has been consistently used as a hypotensive agent in FESS. Dexmedetomidine has been found effective as a hypotensive agent by various investigators when compared to Esmolol or to other drugs such as by Usha bafna et al,[23] M. Ravikumar et al,[24] Tarak shamet al,[25] Iclal Ozdemir koi et al,[26] Sukhminder Jit Singh Bajwa et al,[27] and DK Bharathwaj et al.[28] Similarly Esmolol, an ultra short acting selective β1 adrenergic antagonist has frequently been used as a hypotensive agent in FESS. It has been found effective by various investigators when compared to Dexmedetomidine or to other drugs like Kakati R et Al,[2] Dr. Rahul. S et al,[29] As described in methodology we randomly divided the pool of 60 eligible patients into two groups of 30 each: group D received Dexmedetomidine and group E received Esmolol as drugs of intervention. All continuous and categorical data have been tabulated and compared by appropriate tests of significance as presented in the results section.

In our study we evaluated the hemodynamic parameters such as SBP, DBP, MAP and HR at different time intervals i.e. at baseline, after loading of study drug, after induction, after intubation thereafter every 10 min till end of surgery and finally at 1 and 5 min after extubation. We also noted the quality of the intra-operative surgical field, emergence time, sedation score, time to first rescue analgesic demand, number of additional intermittent doses of vecuronium and adverse effects as defined.

On analysis of MAP we observed that both groups showed decline in MAP after loading dose of study drugs. The MAP in group D declined to 74.89 ± 1.31 mm of Hg from baseline value of 92.22 ± 1.75 which is 18.7 %. In comparison, MAP in group E declined to 76.04 ±2.5 mm of Hg from baseline value of 91.80 ± 2.26 which is 17.1%. The decline in group D is found to be significantly higher as compared to group E with p value < 0.05. Similar findings in MAP were observed following induction and intubation where decline in MAP in group D was significantly higher when compared to group E with p value < 0.05.The fall in blood pressure in group D is mainly due to inhibition of central sympathetic outflow and also due to stimulation of presynaptic α2 adrenoceptors decreasing norepinephrine release, whereas Esmolol lowers arterial blood pressure through a decrease in cardiac output secondary to negative chronotropic and inotropic effects of β- adrenergic antagonism.

Intra-operatively both groups were able to maintain MAP in range of 65-75 mm of Hg with no significant intra-group difference. Following stoppage of study drugs 5 minutes before predicted end of surgery both groups showed rise in MAP. Mean MAP in group D increased to 77.07 ± 0.99 mm of Hg at 5 min after extubation from its from mean of 72.36 ± 1.13 which

was at the end of surgery showing a rise of 6.4% while the Group E showed a maximum rise at 5 min after extubation to a mean of 87.84 ± 1.35 mm of Hg from mean of 77.07 ± 1.54 at the juncture of end of surgery depicting a rise of 13%. The rise in group E is found to be statistically significant. (p= <0.0001).

Our findings were similar to the studies conducted by Usha bafna et al,[23] M. Ravikumar et al,[24] and Tarak sham et al.[25] They also observed that rise in MAP after stoppage of study drugs was significantly higher in group E as compared to group D. This trend in blood pressure is because of shorter context sensitive half-life of esmolol as compared to dexmedetomidine.

On analysis of SBP, DBP and HR, we observed the similar pattern like MAP. Following stoppage of study drugs 5 min before predicted end of surgery, both groups showed rise in their mean values at 1 and 5 min after extubation as compared to their mean values at end of surgery. This indicate that Dexmedetomidine provides better hemodynamic control as compared to Esmolol.

The mean SBP in group D increased to a mean of 106.00 ± 1.49 mm of Hg at 5 min after extubation from 97.07 ± 1.64 which was at the end of surgery showing a rise of 9.2 %.

In comparison group E showed a maximum rise of SBP to a mean of 113.80 ± 2.48 mm of Hg from the value of 103.47 ± 2.16 at the end of the surgery depicting a rise of 9.98%.

The rise in group E is found to be statistically significant. (p= <0.0001).

Other investigators like Iclal Ozdemir koi et al,[26] and Sukhminder Jit Singh Bajwa et al,[27] also observed similar trends in SBP in Dexmedetomidine group as compared to Esmolol.

They also observed that rise in SBP was significantly higher in Esmolol as compared to Dexmedetomidine after stoppage of study drugs.

Similarly, intra-operatively mean SBP is found to be significantly higher in group E as compared to group D with p value < 0.05.

On analysis of DBP we observed that mean DBP in group D increased to a mean of 62.53 ± 1.38 mm of Hg at 5 min after extubation from mean of 60.00 ±1.38 which was at the end of surgery showing a rise of 4 % while the Group E showed a maximum rise at 5 min after extubation to a mean of 74.87 ± 2.27 mm of Hg from mean of 63.87 ± 2.11 at the end surgery

depicting a rise of 17%.

The rise in group E is found to be statistically significant. (p= <0.0001).

Usha bafna et al,[23] also concluded that rise in MAP, SBP and DBP was higher in Esmolol group as compared to Dexmedetomidine group following stoppage of drug infusion five minutes before anticipated end of surgery.

M. Ravikumar et al,[24] compared Dexmedetomidine and esmolol in fifty ASA I patients undergoing FESS. They also observed that both the drugs were able to achieve and maintain controlled hypotension intraoperatively but dexmedetomidine provided better hemodynamic control as compared toesmolol.

Tarek Shams et al,[25] conducted a prospective, randomized, single blinded study in Forty patients to evaluate the efficacy of Dexmedetomidine as a hypotensive agent in comparison to Esmolol in (FESS) and concluded that rise in MAP was higher in Esmolol group as compared to Dexmedetomidine group following stoppage of drug infusion five minutes before anticipated end of surgery.

Sukhminder Jit Singh Bajwa et al,[27] conducted a prospective randomized study in 150 patients to compare Nitroglycerine, Esmolol and Dexmedetomidine for inducing controlled hypotension in patients undergoing FESS and observed better hemodynamic control with Dexmedetomidine as compared to Esmolol.

However some investigator like Kakati R et al,[2] observed that the Esmolol group was associated with a more rapid onset as well as a greater extent of controlled hypotension with better hemodynamic control as compared to Dexmedetomidine.

On analysis of HR we observed that group D displayed a mean HR of 75.63 ± 1.81 bpm at 5 min after extubation which is 7% (5bpm) rise from juncture of the end of surgery. On the other hand rise in HR was more prominent in Group E with a mean value of 89.33 ± 2.8 at 5 min after extubation which is 17% (13bpm) rise from the point of end of surgery. The apparently higher rise in Group E is statistically significant (p= <0.0001). This rise in heart rate in group E is due to low elimination half-life of Esmolol (9 minutes) as compared to Dexmedetomidine (120-180 minutes).

Similarly intra-operatively mean HR was significantly higher in group E as compared to group D with p value <0.05.

Other investigators also like Usha bafna et al,[23] also found better control of heart rate in Dexmedetomidine group as compared to Esmolol group. On analysis of the quality of surgical field, assessed by the operating surgeon using Average Category Score, we observed that mean score in both the groups was between 1-3 indicating good quality of surgical field. However the ACS score was significantly higher for group E 30 min onwards till end of surgery with p value < 0.05. Our findings were similar to the findings in the study conducted by Dr. Manjunath et al,[30] Iclal Ozdemir Kol et al,[26] and

Soma Ganesh Raja Neethirajan et al(20) Dr. Manjunath et al,[30] conducted a randomized study in 60 ASA I-II patients to evaluate the efficacy of Dexmedetomidine on intraoperative bleeding and duration of the surgery in patients posted for Tympanoplasty & FESS and concluded that Dexmedetomidine provides a considerable reduction in bleeding providing a clear field for surgery which is in accordance with our study.

Soma Ganesh Raja Neethirajan et al,[20] conducted a Randomized Controlled Trial study in 92 ASA I-II patients to assess the effectiveness of Dexmedetomidine in decreasing intraoperative blood loss during FESS when used for controlled hypotension. They concluded that Dexmedetomidine effectively decreases blood loss by providing controlled hypotension and better surgical field.

Iclal Ozdemir Kol et al,[26] conducted a study to compare the effects of desflurane combined with Esmolol or Dexmedetomidine on the amount of blood in the surgical field, recovery time, and tolerability in adult patients undergoing tympanoplasty. They concluded that both Esmolol and Dexmedetomidine provided optimal surgical field by limiting intra-op blood loss. These findings are in accordance with our study.

On analysis of requirement of additional intermittent doses of vecuronium. We observed that in group E 50 % patients needed additional intermittent doses of vecuronium with 40% amongst them required 2 additional doses which was significantly higher (p value < 0.05) as compared to group D in which only 20 % (n=6) were given an additional single intermittent dose and none of them were given the 2nd dose. This indicates that Dexmedetomidine has additional anaesthetic sparing effects.

Emergence time, measured as the time between stoppage of anesthetic agents and response to verbal commands, was significantly longer in D group (7.13±1.01) as compared to group E (4.90±1.21) with p value <0.0001, showing that the Dexmedetomidine group had a delayed recovery compared to the Esmolol group. This is due to long elimination t ½ of Dexmedetomidine as compared to Esmolol producing residual effect. This finding was inconcurrence with the study conducted by Kakati R et al,[2] and M. Ravikumar et al,[24] In the post operative period, the sedation score of the patients in the E group were lower, at 20 and 40 minutes, indicating a shorter half- life of Esmolol compared to that of Dexmedetomidine. By 60 minutes in the postoperative period, the sedation score of patients belonging to both the groups became comparable. This finding was similar to the finding in the study conducted by Usha bafna et al,[23] and Tarek sham et al.[25]

The first analgesic request was significantly earlier in the E group (30.67 ± 6.48 min) as compared to the D group (53.23 ± 5.84min) with p value<0.0001. So we observed that postoperative pain relief is significantly better with Dexmedetomidine compared to Esmolol.

The sedative and analgesic sparing effect of Dexmedetomidine is due to its central actions in the locus ceruleus, stimulation of α2 receptors at the substantia gelatinosa of spinal cord, inhibition of release of substance P, and preventing noradrenaline release at the nerve endings. Other investigators like Sukhminder Jit Singh Bajwa et al,[27] and Kakati R et al,[2] also observed that Dexmedetomidine provided prolonged analgesia as compared to Esmolol.

It is obvious from our statistical data that although both drugs were able to achieve and maintain controlled hypotension with MAP in range of 65-75 mm of Hg, but Dexmedetomidine provides better control of hemodynamic parameter as compared to Esmolol. Dexmedetomidine also provides prolonged post-operative analgesia with reduced intra-operative anaesthetic requirement.

CONCLUSION

Both Esmolol and Dexmedetomidine are safe and effective in providing controlled hypotension and ideal surgical condition during FESS.

However, Dexmedetomidine provides better and stable hemodynamic control as compared to Esmolol. Dexmedetomidine also provides an additional benefit of prolonged post-operative* analgesia, conscious sedation and reduced anaesthetic requirements.

None of the drugs were associated with any adverse effects.

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